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| IN RE APPLICATION OF | : |
| Akinobu KAKIMOTO, et al. | : EXAMINER: STOUFFER, KELLY M. |
| SERIAL NO: 10/511,440 | : |
| FILED: OCTOBER 25, 2004 | : GROUP ART UNIT: 1792 |
| FOR: PROCESSING DEVICE USING SHOWER HEAD STRUCTURE AND PROCESSING METHOD | : |

# REPLY BRIEF

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

SIR:

This is a Reply to the Examiner's Answer dated May 20, 2008.

## I. STATUS OF THE CLAIMS

Claims 7-19 are pending. Claims 7-19 stand rejected, and the rejection of Claims 7-19 is herein appealed.

## II. GROUNDS FOR REJECTION TO BE REVIEWED ON APPEAL

Whether Claims 7-19 are unpatentable under 35 U.S.C. § 103(a), as obvious over U.S. Patent Application Publication No. 2002/0034857 to Park (hereinafter "Park").

## III. ARGUMENT

The Examiner's Answer clarifies certain aspects of the final rejections. Nevertheless, Appellants still believe that the final rejections are improper for the reasons provided in the Appeal Brief, and for the following additional reasons, which address points raised in the Examiner's Answer.

### A. Park Does Not Recognize the claimed Head Distance As A Variable That Achieves a Recognized Result.

The Examiner's Answer acknowledges that "Park et al. does not include using the claimed gas velocities or showerhead distances with the claimed relationship"[1] but states that:

> Park et al. includes changing the position of the substrate relative to the heater in paragraph 0041 and in Figure 3. One would recognize that when looking at the apparatus labeled in Figure 1, by changing the height relative to the heater Park et al. is also changing the height relative to the showerhead and hence the area as described in claim 7. This change of distance occurs in Park et al. to affect the substrate temperature (paragraphs 0041 and 0047) that determine crystallinity in the film and leakage current (paragraphs 0004-0008). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Park et al. to include distances between the substrate and the heater, and consequently, the substrate and the showerhead within the ranges of those claims by routine experimentation in order to achieve an optimal amount of crystallization and leakage current.[2]

This line of reasoning is inconsistent with the law. Only result-effective variables can be optimized. M.P.E.P. § 2144.05 (IIB), citing *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977), states that "a particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation." The claims on appeal in *In re Antonie* recited a wastewater treatment

[1] See the Examiner's Answer at page 5, lines 1-2.
[2] See the Examiner's Answer at page 6, line 13 to page 7, line 2.

device with a ratio of tank volume to contactor area of 0.12 gal./sq. ft.[3] The court in *In re Antonie* noted that the primary prior art applied by the Patent Office taught the basic structure of the claimed device claimed, but was "silent regarding quantitative design parameters other than to give data on a single example."[4] In this case, no dimensions are given for the process chamber illustrated in Figure 1 of Park, no dimensions are given for *head distance*, and Park does not recognize that *head distance* achieves a recognized result.

The distinct variables of *head distance* and *separation distance* can be understood with reference Figures 1 and 6A of Park, reproduced below. Claim 7 of the present application recites "a head distance between the gas jetting surface and the mounting table." Thus, in the context of Figure 1 of Park, the "head distance" of Claim 7 of the present application is the distance between the holes 21a in the showerhead 21 of Park and the mounting surface of the stage 31. "Separation distance," as taught by Park, on the other hand, can be understood as the separation distance between the heater 14 and the wafer or the stage 31 of Park, illustrated as element "d" in Figure 6A of Park.

FIG. 1

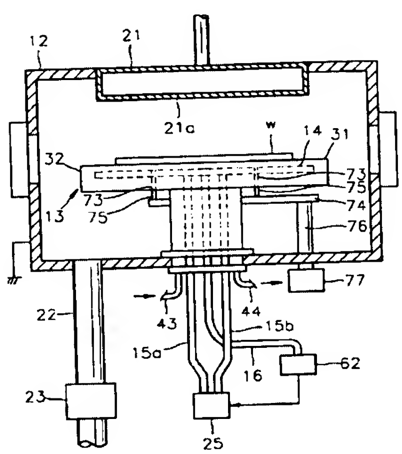
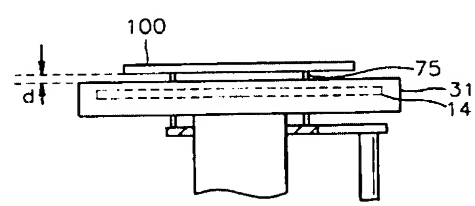



FIG. 6A




[3] See, *In re Antonie*, 559 F.2d 619.
[4] See, *In re Antonie*, 559 F.2d 619.

Paragraph [0033] of Park states that "[a]s realized by the present inventors, in general, the temperature at positions in the chamber 12 is related to a separation distance between the heater 14 and the positions in the chamber 12," and that paragraph [0034] of Park further states (emphasis added) "the temperature of the wafer can be changed by changing the ***separation distance between the heater 14 and the wafer or the stage 31***." Thus, Park recognizes that separation distance achieves a recognized result for controlling temperature.

However, Park is absolutely silent with respect to any particular result being achieved by changing *head distance*. The Examiner's Answer's statement that "by changing the height relative to the heater Park et al. is also changing the height relative to the showerhead" fails to recognize that the initial head distance, which is selected when the chamber is constructed, is itself a variable that is *independent from* any subsequent change in head distance that is caused by changing separation distance. This is a critical mistake, because Park makes no statement as to what particular head distance is preferable or why. That Park's variation of the spacing between the support and the wafer would incidentally change the distance to the showerhead in no way suggests Park recognizes head distance as a variable to be optimized. Park does not disclose that bringing the showerhead 29 closer to the wafer w achieves any recognized result. Park does not disclose that spacing the showerhead 29 further from the wafer w achieves any recognized result. Park does not state that any particular initial dimensions for the head distance are important. Park merely describes that head distance *changes* when separation distance changes. Thus, at best, Park suggests that even though head distance *changes* when separation distance changes, the initial or actual head distance is unrelated. In terms of temperature (the result being optimized in Park by spacing between the wafer and the heater of the support), any size chamber would do, any initial head distance would do, and there are no recognized results of beginning with a head distance that is 10 mm

rather than 100 mm. Moreover, as discussed further hereinafter, even if Park did teach optimizing head distance, there is absolutely no teaching of optimizing gas jetting velocity, much less the combined interrelationship of head distance and gas jetting velocity as in the present invention.

By contrast, Appellants have discovered an importance in the relationship between head distance and gas jetting velocity. For example, as noted at page 15, lines 20-25 of Appellants' specification, by restricting the relationship between the head distance and gas jetting velocity to within the shaded area depicted in Figure 3 of Appellants' original disclosure, a wafer can be processed in a highly uniform manner, with improved processing efficiency, and improved throughput. In particular, page 16 line 1 to page 25, line 6 of Appellants' specification describes with reference to Figures 4-9 how the claimed range was determined.

Nevertheless, the Examiner's Answer asserts that because head distance changes as a result of optimizing the distinct variable of separation distance, head distance is also optimized. However, a first variable (head distance) that *changes* as the result of optimizing a second, independent variable (separation distance) is not the same as *optimizing* the first variable. In other words, although *changing* head distance may be an incidental consequence of optimizing separation distance, the effects of changing head distance (which Appellants recognized as affecting uniformity, processing efficiency, and throughput) are nevertheless independent of the effects of heating caused by optimizing separation distance. As Park has not recognized that changing the variable of head distance achieves any recognized result, head distance is not a result-effective variable, and the claimed ranges are not a matter of routine optimization.

**B. Park Makes No Mention Of Gas Jetting Velocities.**

The Examiner's Answer acknowledges that "Park et al. does not include using the claimed gas velocities or showerhead distances with the claimed relationship."[5] Indeed, Park does not mention gas jetting velocities in any manner, whatsoever. Nevertheless, the Examiner's Answer states that:

> Park et al. additionally includes changing the chamber pressure in paragraph 0041 for the same reasons. One of ordinary skill in the art would realize that chamber pressure is directly affected by gas flow from a showerhead, and therefore it is obvious that this variable be modified by routine experimentation as well. Though the applicant asserts that changing gas jetting velocity does not necessarily result in a change of pressure if an outlet port is adjusted, it is clear from Park et al. that the pressure is increased in paragraph 0041, for example, and therefore increasing pressure of the gas would be caused by an increase in gas flow velocity. Further, movement of the substrate relative to the heater and therefore relative to the showerhead, discussed above as a result effective variable, would obviously effect the gas jetting velocity relative to the substrate - supporting that the gas jetting velocity is shown to be a result effective variable dependant upon many experimental conditions.

The Examiner's Answer's statement that "[o]ne of ordinary skill in the art would realize that chamber pressure is directly affected by gas flow from a showerhead" is a statement of inherency (it is inherent that a pressure change results in / is caused by a change in gas jetting velocities). This statement is incorrect, speculative, and completely unsupported by Park. As noted on pages 8-9 of the Appeal Brief, regardless of whether Park describes that *pressure* can be optimized within the chamber 12, the *gas jetting velocity* is determined by many different parameters, such as gas flow rate at an inlet port and number and size of gas jetting holes. Likewise, the *pressure* can be changed by a number different methods other than by increasing gas jetting velocities. For example, simply adding more fluid into the

[5] See the Examiner's Answer at page 5, lines 1-2.

enclosed space of the chamber at a single, constant gas jetting velocity may result in a higher pressure, or exhausting gasses may reduce pressure without changing the velocity of gasses jetted into the chamber.

Park makes no mention as to *how* pressure is changed. The Examiner's Answer nevertheless relies on a circular line of reasoning, stating that "[t]hough the applicant asserts that changing gas jetting velocity does not necessarily result in a change of pressure if an outlet port is adjusted, it is clear from Park et al. that the pressure is increased in paragraph 0041, for example, and therefore increasing pressure of the gas would be caused by an increase in gas flow velocity." Appellants disagree with the Examiner's Answer's statements that simply because "it is clear from Park et al. that the pressure is increased in paragraph 0041," it necessarily follows that "increasing pressure of the gas would be caused by an increase in gas flow velocity." As was noted in the Appeal Brief "[t]o establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is ***necessarily*** present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may ***not*** be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.'" *In re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999) (emphasis added) (citation omitted) (quoting *Continental Can Co. USA, Inc. v. Monsanto Co.*, 948 F.2d 1264, 1268, 20 USPQ2d 1746, 1749 (Fed. Cir. 1991)). "That which may be inherent is not necessarily known. Obviousness cannot be predicated on what is unknown." *In re Spormann*, 363 F.2d 444, 448, 150 USPQ 449, 452 (CCPA 1966). Such a retrospective view of inherency is not a substitute for some teaching or suggestion supporting an obviousness rejection. *See In re Newell*, 891 F.2d 899, 901, 13 USPQ2d 1248, 1250 (Fed. Cir. 1989).

In this case, there are *several* different ways that pressure could be changed other than changing gas jetting velocities. Therefore it does not necessarily follow that a change in pressure was caused by gas jetting velocities, of which Park makes no mention, whatsoever.

Further, the Examiner's Answer statement that "movement of the substrate relative to the heater and therefore relative to the showerhead...would obviously effect the gas jetting velocity relative to the substrate - supporting that the gas jetting velocity is shown to be a result effective variable dependant upon many experimental conditions," is also unsupported. Moreover, such a statement is largely irrelevant, because Claims 7 and 12 do not recite gas jetting velocity *relative to the substrate*, but instead respectively recite "a gas jetting velocity *from the gas jetting holes*" and "a velocity of the processing gas *from the plurality of gas jetting holes*." (Emphasis added.)

Accordingly, Park does not recognize (or even mention) the claimed gas jetting velocities as achieving any recognized result. Thus, the claimed gas jetting velocities are not a result-effective variable, and the claimed ranges are not a matter of routine optimization.

### C. Park Makes No Mention Of Relating Head Distance To Gas Jetting Velocities.

Regardless of whether Park recognizes either head distance or gas jetting velocities as a result-effective variables (which it does not), Claims 7 and 12 each recite *a relationship between* head distance and gas jetting velocities. Thus, even assuming, for the sake of argument without conceding the point, that it would be a matter of obvious optimization to arrive at ideal head distance and gas jetting values, nothing in Park suggests that *the relationship between* head distance and gas jetting velocities achieves any recognized result. Indeed, the Examiner's Answer acknowledges that "Park et al. does not include using the

claimed gas velocities or showerhead distances with the claimed relationship."[6] Thus, the claimed relationship between gas jetting velocities and head distance is not a result-effective variable, and the claimed ranges are not a matter of routine optimization.

Accordingly, Park fails to disclose or render obvious all of the features in independent Claims 7 or 12. It is respectfully requested that the rejection of Claims 7 and 12, and the claims depending therefrom, be reversed.

**D. The Evidence of Criticality Is Commensurate With The Scope Of The Claims.**

The experimental results set forth in Appellants' specification isolate the effects of gas jetting velocities and shower head distance on substrate processing. In particular, Appellants varied gas jetting velocities and shower head distance while holding other variables (precursors, films, temperature, pressure, and wafer sizes) constant within each experiment. As noted at page 15, lines 20-25 of Appellants' specification, Appellants recognized that by restricting the relationship between the head distance and gas jetting velocity to within the shaded area depicted in Figure 3, a wafer can be processed in a highly uniform manner, with improved processing efficiency, and improved throughput. Page 16, line 1 to page 25, line 6 of Appellants' specification and Figures 4-9 of the original disclosure provide ample evidentiary support for the criticality of the range illustrated in Figure 3. The claimed range of gas jetting velocities and head distances is not outside of this range, but is identical to this range. Thus, the scope of the claimed range is not only commensurate with, but *is identical to*, the range for which the evidence demonstrates criticality.

[6] See the Examiner's Answer at page 5, lines 1-2.

Nevertheless, the Examiner's Answer states:

> As for showing criticality of the claimed values and the applicant's citation of the specification and Figures 4-9 as evidence of criticality of the claimed values, the examiner notes that evidence of criticality can only be shown when the evidence is commensurate in scope with the claims. The specification and drawings provide support for criticality of these values for only particular precursors, films, wafer sizes, etc. and not all gaseous precursors with all possible wafer sizes and films as claimed in the independent claims. The applicant provides no evidence showing that the critical values of gas jetting velocity and substrate/showerhead distances from the specific precursors and process parameters shown in the instant disclosure are applicable to the entire scope of the claims.[7]

Appellants respectfully disagree with the Examiner's Answer that "the specification and drawings provide support for criticality of these values for only particular precursors, films, wafer sizes, etc." It is submitted that one of ordinary skill in the art would recognize that the criticality of a variable can be shown by changing *only that variable* while others are held constant, and that such criticality would not be limited *only* to the exact environment created by holding the other variables constant in order to isolate the critical variable. Appellants are not aware of any requirement that multiple (potentially infinite) other experiments must be conducted to further demonstrate that a critical range holds true for *all values and variations* of *all the variables* present when the experiment was conducted. Indeed, it is inconceivable that an Applicant would be required to completely exhaust all possible variations of the variables that were held constant (such as humidity, temperature, pressure, precursors, films, etc.) during an experiment and fully document the results before they met the burden that the experiments then demonstrated criticality.

Moreover, Appellants are not aware of any requirement that, in order to recite a range in a claim when the criticality of that range is supported by an experiment, the value at which

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[7] See the Examiner's Answer at page 7, line 15 to page 8, line 2.

*every variable* was held constant during the experiment must be claimed. Nevertheless, this is precisely what the Examiner's Answer is proposes. It is inconceivable that an Applicant be required to claim the specific values of *every parameter* in an experiment in order to claim a critical range. The list of parameters could potentially be endless, and such a claim would be several volumes thick. Such a requirement is inconsistent with the law.

Further, regarding the wafer size, Appellants' specification as originally filed states, at page 22:

> The processing apparatus of the present invention described above was the one applicable to a wafer having a size of 200 mm and had a head distance L1 of about 77 mm. However, the wafer size is not limited to 200 mm. For example, the present invention can be applied to a processing apparatus for treating a wafer of a size of 300 mm. In case of the processing apparatus for a wafer of a size of 300 mm, a diameter of each of the mounting table 32 and the shower head structure 6 is increased to match the increase in the wafer size. However, the head distance L1 can be conversely set to be smaller, for example, about 15 mm, to cope with a demand for a size reduction of a processing apparatus.

Thus, even if the wafer size is changed, by changing a diameter of each of the mounting table and the shower head structure to match the change in the wafer size, Appellants invention can be applied to a wafer having different sizes, as disclosed above.

Further, dependent Claims 8 and 13 each recite that "the processing gas contains ozone for reforming a metal oxide film formed on a surface of the object to be processed," and dependent Claims 9 and 14 recite that "the metal oxide film is a tantalum oxide film." Thus, dependent claims 9 and 14 in combination with dependent claims 8 and 13 limit the process gas to a processing gas that contains ozone for reforming a metal oxide film formed on a surface of the object to be processed, and limit the metal oxide film to a tantalum oxide film.

Therefore, even if, assuming *arguendo*, the ranges of gas jetting velocity and head distance in independent Claims 7 and 12 are determined not be commensurate with the scope of criticality demonstrated in the specification, Claims 9 and 14 in combination with Claims 8 and 13 are believed to be commensurate with the scope of the criticality demonstrated in Appellants' disclosure as originally filed.

**E. Conclusion.**

In view of the foregoing, it is respectfully submitted that the cited references, whether considered alone or in combination, fail to disclose or suggest the combined features set forth in Claims 7-19. Accordingly, it is respectfully requested that the rejections of Claims 7-19 be reversed.

Respectfully submitted,

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